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# Evaluation of variables influencing success and complication rates in canine total hip replacement: results from the British Veterinary Orthopaedic Association Canine Hip Registry (collation of data: 2010–2012)

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Title: “Evaluation of variables influencing success and complication rates in canine total hip replacement: results from the BVOA Canine Hip Registry” (collation of data: 2010-2012)


***Summary***

**Objective:** To assess the variables associated with the complications of total hip replacement (THR) and report owner-assessed outcomes.

**Methods:** Entries into the British Veterinary Orthopaedic Association-Canine Hip Registry (BVOA-CHR) between September 2011 and December 2012 were reviewed separately and in conjunction with previous data. An online, owner-administered outcomes assessment questionnaire (modified from the Liverpool Osteoarthritis in Dogs (LOAD) questionnaire) was used to collect outcomes data from owners.

**Results:** The incidence of surgeon and owner reported complications were 8.2% and 4.3% respectively. No significant association was identified between bodyweight, age, sex, breed or indication for THR and the incidence of complications. THR using the BFX cup/stem prosthesis had a significantly greater likelihood of complication compared to when using the CFX cup/stem prosthesis ($p=0.002$); a complication was 4.48 times more likely to occur when using the BFX cup/stem prosthesis versus the CFX cup/stem prosthesis. THR using the BFX cup/stem prosthesis had a significantly higher likelihood of complication compared to when using a hybrid prosthesis (BFX cup/CFX stem, CFX cup/BFX stem) ($p=0.046$); a complication was 2.85 times more likely to occur when using the BFX cup/stem prosthesis versus a hybrid prosthesis. In 95% of cases, owners described their satisfaction with the outcome of THR as ‘very good’ or ‘good’.

**Conclusions:** Complication rates from the BVOA-CHR are similar to previous studies. ‘Surgeon’ and ‘clinic’ are not variables in our analysis (contractual) but the data suggest that prosthesis type has a relationship with complication rate, with Biomedtrix BFX (circa 2012) having a high short-term complication rate.

***Introduction***

The BVOA-CHR (British Veterinary Orthopaedic Association-Canine Hip Registry http//:www.caninehipreplacement.org), hosted at the University of Liverpool Veterinary School, is an online database established in January 2010 (1). The aim of the registry is to collate data from multiple veterinary referral clinics regarding techniques and complications associated with canine total hip replacement (THR) through surgeon-based registration of cases, informed owner consent, and prospective outcomes assessment using a client-administered online clinical metrology instrument. The BVOA-CHR offers an ongoing follow-up on all cases submitted, whereby surgeons are encouraged to document complications as and when necessary, months or even years after surgery. A previous report by Forster et al (2012) describes 170 cases of THR. Continued submission of complications associated with these cases can occur and therefore enable long-term complications of THR to be reported.

THR is a successful surgical treatment for debilitating conditions of the coxofemoral joint, providing high success and low complication rates. Success rates for either cemented or cementless THR have been reported at 80% to 98% based on both clinical and radiographic evaluation of pain status and functionality, and owner assessment (2, 3, 4, 5, 6, 7, 8, 9). Previous results obtained from the BVOA-CHR revealed that in 94% of cases owners described their satisfaction with the outcome of THR as “very good” or “good” (1).

Complication rates after THR usually range between 5 and 20% although different rates have been described owing to the wide variety of systems used in different populations (3, 10, 11, 12, 13). Complications previously reported using data obtained from the BVOA-CHR included luxation, femoral fracture, minor wound dehiscence, wound sepsis, protrusio acetabuli, acetabular cup displacement, suspected pulmonary thromboembolism and death at end of surgery, femoral pain, femoral subsidence, and sciatic paresis (1). Other major complications include aseptic loosening, septic loosening, femoral medullary infarction and patellar luxation. (4, 9, 14, 15, 16). A revision rate of up to 11% has been documented with cemented THR (16) with reported complications including femoral fracture (17) luxation (18) implant loosening (12) and infection (19). Cementless fixation of the acetabular component has become increasingly popular because the long-term results of cemented total hip

arthroplasty in humans have shown that late failure is often associated with loosening of the acetabular component (20, 21). Cementless THR have reported similar complication rates to that of cemented prostheses (5, 6, 13). Using a combination of cemented femoral and cementless acetabular components has recently been described as an alternative to either entirely cemented or cementless implantation. (10, 22).

While a handful of studies reporting each system individually and their success and complication rates are available, the case numbers remain relatively small. Using data obtained from the BVOA-CHR, our aims were (i) to identify any significant association or correlation between patient background variables (age, body weight, breed, and sex) and surgical variables (indication for surgery, prosthesis used) and the incidence of complications; and (ii) using the Liverpool Osteoarthritis in Dogs (LOAD) (23, 24) scores from an owner-assessed outcomes questionnaire, to report the owner-assessed outcome of THR.

***Materials and Methods***

The structure and workings of the BVOA-CHR have been previously described (1). Briefly, information on each THR was submitted on a Microsoft Sharepoint site. Complications were submitted separately and were cross-referenced to the original surgery by the registry administrator. Complications were categorised as 'catastrophic', 'major' and 'minor' according to the definitions of Cook et al (25). Participating surgeons signed a confidentiality disclosure agreement (CDA) with the University of Liverpool Veterinary School stating that the variables of "surgeon" or "clinic" would not be used in data analyses. Participating surgeons were encouraged to submit all operated cases to the BVOA-CHR.

Records of the BVOA-CHR database between September 2011 and December 2012 were exported to an Excel spreadsheet (I) and reviewed. Inclusion criteria included a fully completed data entry for all variables. A total of 140 THR cases were analyzed with136 cases meeting the inclusion criteria for the study; 4 cases were unavailable for use because of inaccurate or missing data. These cases were collated with records of the BVOA-CHR database between January 2010 and August 2011 (1), resulting in a total of 306 cases.

Complications could also be submitted by the owner via a questionnaire. The same online owner-administered outcomes assessment questionnaire was used as previously reported (1); a questionnaire modified from the 'Liverpool Osteoarthritis in Dogs' (LOAD) clinical metrology instrument (24). Briefly, the questionnaire was divided into four sections. Section A was composed of 10 questions and assessed information regarding length of on-going mobility problem, medications received, and other concurrent medical history unrelated to hip dysplasia. Section B was composed of 13 questions and assessed activity and willingness to exercise before THR. Section C was composed of three questions and assessed whether unilateral or bilateral THR was carried out, overall owner satisfaction, and complications reported. Finally, section D was composed of 13 questions and assessed activity and willingness to exercise after THR. Questions and scoring were identical in sections B and D enabling a pre- and post-THR lameness score to be calculated. The complete questionnaire was sent to cases where the date of surgery was between September 2011 and December 2012 (Group One, < 16 month follow up), whereas a modified follow-up questionnaire containing only sections C and D was sent to cases where the date of surgery was prior to September 2011 (Group Two, 17 - 36 month follow up). For those cases without a contact email address, the questionnaire was sent via postal service.

***Statistical Analysis***

The dataset was reviewed and checked for coding of all variables. Descriptive statistics were calculated for each variable and data were analyzed using software (II). Statistical significance was set at $P<0.05$. Associations between each variable and the incidence of complications were assessed using logistic regression analysis. Univariable binomial logistic regression was used to calculate measures of strength of association for each variable with the presence of complications. A Mann Whitney U-test was performed using the SPSS statistical software package to assess the significance of total lameness scores before and after THR and between groups.

***Results***

One hundred and thirty six THR cases met the inclusion criteria and were reported by veterinarians via online submission (September 2011 – December 2012). These new reports were combined with those

previously reported, resulting in a 306 cases (1) (January 2010 – August 2011).

Cases were recorded by twenty-four veterinary surgeons from twenty small animal clinics with the United Kingdom. The average case contribution per surgeon was 12.75 cases (range; 1- 41 cases/surgeon). Dogs ranged from less than 1 year to 12 years of age (mean ± SD, 3.38 ± 2.86 years), with 39% of dogs being less than two years old, and weighing 4.00–72.00 kg (mean, 28.47kg ± 10.80 kg). There were 129 female (40 intact, 89 neutered) and 177 male dogs (110 intact, 67 neutered). The Labrador Retriever (n = 91), German Shepherd dog (n = 43), Crossbreed (n = 39), Border Collie (n = 27), Golden Retriever (n = 16), Rottweiler (n = 13), English Springer Spaniel (n = 11), West Highland White Terrier (n = 10) and Cocker Spaniel (n = 7) were the most frequently represented breeds. Indications for surgery included hip dysplasia and osteoarthritis (n = 268), recurrent luxation (13), avascular necrosis of the femoral head (8), Legg-Calves-Perthes disease (7), fracture (7), and traumatic luxation (3). Surgical implants included BioMedtrix CFX cup/stem (III; n = 140), BioMedtrix hybrid (III; n = 74); using BioMedtrix BFX cup and CFX stem (III; n = 68) or BioMedtrix CFX cup and BFX stem (III; n = 6), BioMedtrix BFX cup/stem (III; n = 39), Helica (IV; n = 34) and Kyon (V; n = 19). Thirty-nine dogs underwent bilateral staged THR.

*Complication Rate*

The BVOA-CHR data collected since January 2010 (306 cases) was combined with information on the incidence of complication, treatment and outcome gained from owner completion of their questionnaire (<24 months following surgery).

The incidence of surgeon-reported surgical complication was 8.2%. The incidence of owner-reported complications was 4.3%. Complications (inclusive of those reported by owner and/or veterinary surgeon) included luxation (n = 11), femoral fracture (9), problems associated with wound healing (9), aseptic loosening (6), acetabular fracture (2), sciatic paresis (1), femoral pain (1), femoral subsidence (1), protrusio acetabuli (1) and cardiac arrest (suspected pulmonary thromboembolism) (1) (Table 1.). Two catastrophic complications occurred; cardiac arrest in a case with hybrid fixation (BFX cup/CFX stem), and femoral fissure that led to euthanasia in a Kyon case (Table 2.). Three minor complications

occurred which were all associated with the CFX cup/stem prosthesis. These included sciatic pain, femoral pain and protrusio acetabuli. The remaining complications (n=37) were classified as major, requiring additional surgical or medical treatment.

Eleven cases of luxation were reported (2 BFX cup/stem, 5 CFX cup/stem, 1 CFX cup/BFX stem, 2 Helica, 1 Kyon). Luxation was reported at 0 (n=2), 8, 10, 18, 57, 235, 300 and 302 days. The time of two cases of luxation was not specified. In one case the hip had luxated during post op radiography; excision of new bone formation which was causing ventral impingement followed by reduction resulted in a successful outcome. Two cases resulted in explantation, in which one case the hip had reluxated on two occasions (302 days and subsequently 363 days). One case was managed with closed reduction and subsequent Ehmer sling application. The remaining cases were managed via open reduction with either the same sized implant or an increased femoral head/neck length.

Three cases of aseptic loosening were reported by the veterinary surgeon and three cases by the owner. Aseptic loosening was reported at 147, 202 and 418 days postoperatively by the veterinary surgeon, all of which occurred when using the Helica prosthesis. Three cases of aseptic loosening were reported by the owner to have occurred in the first three months following surgery (BFX cup/stem n=2, Helica n=1). Revision surgery occurred in four cases whereas explantation of the implant occurred in two cases.

Nine femoral fractures were reported (5 BFX cup/stem, 1 CFX cup/stem, 1 BFX cup/CFX stem, 2 Kyon). On both occasions where the fracture occurred intraoperatively (CFX cup/stem, n=1, BFX cup/stem, n=1), successful repair was carried out using cerclage wire alone, without explantation. Femoral fracture occurred 17 days post surgery using the Kyon prosthesis; the animal was euthanased. A further 7 cases of femoral fracture were reported, of which 5 (4 BFX cup/stem, 1 BFX cup/CFX stem) were treated successfully and 1 case (BFX cup/stem) required explantation. Femoral fracture occurred in 7 cases, which used a cementless femoral prosthesis (5 BFX cup/stem, 2 Kyon), and 2 cases using a cemented femoral prosthesis (1 CFX cup/stem, 1 BFX cup/CFX stem).

When accounting for all complications, ten cases that had complications were identified with the CFX

cup/stem prosthesis (3.3%), 10 with the BFX cup/stem prosthesis (3.3%), 8 with a hybrid prosthesis (2.6%), 6 with the Helica prosthesis (1.9%) and 4 with the Kyon prosthesis (1.3%) (Table 1). In some cases, more than one type of complication occurred (n=3). However, statistical analysis was completed on the basis of whether the case had a complication, be that one or several (Table 3). No statistical significance was identified between weight, age, gender, breed or indication for THR and the incidence of complications. A relationship between prosthesis and the occurrence of complications (inclusive of catastrophic, major and minor complications) was identified. THR using the BFX cup/stem prosthesis had a significantly different likelihood of complication compared to when using the CFX cup/stem prosthesis ($p=0.002$). A complication was 4.48 times more likely to occur when using the BFX cup/stem prosthesis versus the CFX cup/stem prosthesis. THR using the BFX cup/stem prosthesis had a significantly different likelihood of complication compared to when using a Hybrid prosthesis ($p=0.046$). A complication was 2.85 times more likely to occur when using the BFX cup/stem prosthesis versus a Hybrid prosthesis. Of the complications using a hybrid prosthesis, 7/8 complications used a BFX cup/CFX stem surgical technique. Complications included fracture of the acetabulum (n=2), wound infection (n=3), cardiac arrest (n=1) and femoral fracture (n=1). One case of luxation occurred with the use of a CFX cup/BFX stem prosthesis. No significant difference in complication rate was found between any of the other prosthetic types.

*Owner Assessment Questionnaire*

*Group One* (136 cases, < 16 month follow up, first completion of questionnaire),

A total response rate of 55% was achieved for group one via the online owner assessment questionnaire. 11% dogs were reported as ‘not at all disabled’ by their lameness before THR. A total of 43% dogs were considered lame by owner assessment for 0-6 months before THR, whereas 25% were lame for 6-12 months, and 32% for more than 12 months before surgery. In the last month before surgery 59% of dogs were receiving 0-1 mile of exercise per day before THR, whereas 25% received 1-2 miles of exercise, and 16% received more than 2 miles of exercise. Of these, 34% received mainly off-lead exercise, whereas 66% received mainly on-lead exercise.

In 81% of cases, owners described their satisfaction with the outcome of THR as ‘very good’, 14% as ‘good’, 1% as ‘fair’ and 4% as ‘poor’. No owners rated their satisfaction as ‘very poor’. There was no significant difference in owner assessed lameness scores between those dogs that had undergone unilateral THR and those that had undergone bilateral THR (preoperatively; $p=0.30$, postoperatively; $p=0.61$). There was a statistically significant difference in owner assessed lameness scores before and after THR ($p<0.001$) with the mean LOAD score before and after THR being 22/52 and 6/52, respectively.

*Group Two* (170 cases 17 - 36 month follow up).

85% of owners that had originally responded to the questionnaire within 24 months of surgery (1) also completed the follow-up questionnaire containing sections C and D only (<36 months following surgery). Three complications previously not reported by either the veterinary surgeon or the owner were identified, aseptic loosening (>6 months post surgery, n=2, BFX cup/stem prosthesis) and dislocation (n=1, CFX cup/stem prosthesis). The time of dislocation post surgery was not provided and contact with the owner to gain further information was unsuccessful.

In 88% of cases, owners described their satisfaction with the outcome of THR as ‘very good’, 6% as ‘good’, 5% as ‘fair’ and 1% as ‘very poor’. No owners rated their satisfaction as ‘poor’. Difference in owner-assessed lameness scores reported (<24 months) after THR and scores reported approximately one year later (<36 months after THR) were significantly different ($p<0.01$) with the mean LOAD score within 24 months of THR being 5.6/52 and approximately one year later being 8.7/52. However, the score reported (<36 months) after THR was still significantly lower than that reported prior to surgery (Preoperative score 18.7/52, $p<0.001$).

***Discussion***

In 95% of cases, owners of animals that had surgery <24 months previously, described their satisfaction with the outcome of THR as ‘very good’ or ‘good’. In 94% of cases, owners of animals that had had surgery <36 months previously, described their satisfaction with the outcome of THR as ‘very good’ or

'good'. The questionnaire was based on LOAD; a validated owner-completed clinical metrology instrument that is recommended for the measurement of canine osteoarthritis, which has documented 'criterion validity' (correlation with force-platform data) (24). The LOAD scores reported both <24 months and <36 months after THR were significantly lower than that reported prior to surgery ($p<0.001$). Seemingly, there is a high degree of owner satisfaction up to 36 months following THR. We appreciate that reliance on owner perception of lameness is not always reliable (26), and that owner interpretation of lameness or the term 'disabled' may differ from that of a veterinary surgeon. Interestingly, 11% of cases were reported as 'not disabled' by the owner prior to THR. The potential that these animals received surgery due to radiographic assessment alone and without overt clinical signs of lameness or pain exists. However, owners' opinion regarding the ability to ambulate is somewhat unreliable, especially when considering cases where bilateral pelvic limb lameness is present. Also, a large proportion of dogs are non-surgically managed via exercise restriction prior to surgery, and therefore interpretation of lameness by the owner can be difficult.

Dogs ranged from less than one year to 12 years of age (mean ± SD, 3.38 ± 2.86 years), with 39% of dogs being less than two years old. A substantial proportion of dogs undergoing THR are less than two years old. In our opinion, prospective monitoring of the performance of THRs is of great importance if we are to assess the longevity and efficacy of this intervention. Continued yearly reporting of the BVOA-CHR will provide information on the success of THR prostheses in such young dogs.

There was not a significant difference in owner-assessed lameness scores between those dogs that had undergone unilateral THR and those that had undergone bilateral THR. However, due to the majority of cases not requiring bilateral surgery (8, 10), the statistical power of this assessment was limited and data for the degree of lameness (LOAD score) between the first and subsequent surgeries was lacking.

Complication rates, gained from collating data from both the BVOA-CHR and owner assessment questionnaire, are similar to previously documented studies (3, 10, 11, 12, 13). An apparent difference between complication rates reported by surgeons and those reported by owners was found, as previously reported by Forster et al (1). Even though the complication rate reported by owners was

lower than that reported by veterinary surgeons, 4.3% and 8.2% respectively, it was found that in some instances perioperative complications were reported by the owners and not by the veterinary surgeon. This could be due to inadequate data input by veterinary surgeons, the animal being represented to a different referral veterinary surgeon when the complication occurs or unreliable data input by the owner.

Several studies report luxation as the most common short-term complication after THR with an incidence of 1.1-8.5% (8, 16, 18, 27). The reported incidence of luxation in this study was 3.6%. Luxation occurred both in cemented (n=5) and cementless (n=7) prosthetic types. When comparing cases collected prior to (1) and after September 2011, a reduction in the number of cases with luxation associated with a CFX cup/stem prosthesis is noted. This could potentially be due to improved positioning of the acetabular cup or the fact that cases of late luxation are yet to be reported.

A single case of protrusion acetabuli was reported. Protrusion acetabuli in this instance was classified as minor due to the lack of medical or surgical intervention reported, according to the definitions of Cook et al (25). It is probable that the complication was perceived to be one that could not be surgically resolved.

The rate of aseptic loosening was 1.9%, similar to previously reported rates of 2.1% to 7.2% (4, 9, 12, 16). Only two cases of aseptic loosening were reported by the owners who completed a questionnaire ≥ 36 months post surgery. The postoperative complication rate of aseptic loosening is low suggesting that the mechanical failure of the implants, bearing surfaces or bone-implant/bone-cement interface is not a significant factor three years after canine THR. However, the reliance on both owners and veterinary surgeons to input data and the fact that cases of aseptic loosening have been described in the absence of clinical signs in dogs (16), means that the true incidence of aseptic loosening might be higher than reported herein. Owners might attribute a gradual deterioration in function to 'natural changes post operatively' and might not report changes to their veterinarian. Post-mortem investigations have identified aseptic loosening in greater than 63.2% of cemented canine THR (28). Further follow-up of THR will be beneficial because the complication rate of any THR technique may increase significantly over time. One study reporting complications of human total hip arthroplasty reported that the rate of acetabular loosening increased from 2% at six years postoperatively to 42% at

11 years postoperatively (29). Cementless fixation of the acetabular component has become increasingly popular because the long-term results of cemented total hip have shown that late failure is associated with loosening of the acetabular component (16, 20, 28). Interestingly, in the data reported in our study, aseptic loosening was reported with cementless prostheses only (Biomedtrix BFX cup/stem, Helica). Due to the fact that an owner reported some of these cases, information regarding specific times post surgery, outcome and type of aseptic loosening i.e. acetabular or femoral component, were not available. The majority of cases of aseptic loosening were reported within the first three months following surgery. Aseptic loosening can be the result of mechanical or biological loss of fixation over time, or inadequate initial fixation. Hayashi et al (2015) reported that Helica aseptic femoral stem loosening was a common complication occurring in 5/16 dogs (30). Within this study aseptic loosening of the femoral stem was reported from 11 weeks to 12 months postoperatively. It is possible that the early reports of luxation in this study are due to inadequate initial fixation versus loss. It is possible that with longer follow-up times a different outcome may emerge such that cementless THR may result in longer survival and less aseptic loosening in comparison to cemented THR.

Complications have been reported after the use of cementless femoral stems including subsidence, intra-operative femoral (fissure) fractures and post-operative femoral fractures (17, 31, 32, 33). Predisposing risk factors for fracture of the femoral stem after THR include osteopathy and iatrogenic fissures created during surgery (17). Although the data is limited, overall it appears that many BFX complications relate to the femoral component, whereas the acetabular component is more reliable (33).

THR using the Biomedtrix BFX cup/stem prosthesis had a significantly greater likelihood of complication compared to when using the Biomedtrix CFX cup/stem prosthesis or a hybrid prosthesis (BFX cup/CFX stem (68), CFX cup/BFX stem (6)). Of the complications incurred with the use of a hybrid prosthesis, only one case involved the femoral component; femoral fracture with use of a CFX stem. Liska et al (17) described an increased concentration of biomechanical forces at the distal end of the femoral stem as a plausible cause of femoral fracture. Cementless femoral fixation has been reported as a risk factor for femoral fracture for human total hip arthroplasty (34). However after a fracture, femoral component survivorship was greater for cementless stems compared to cemented stems. These data suggest

Biomedtrix BFX has a high short-term complication rate, associated with the femoral stem. Overall the incidence of femoral fracture (2.9%) was greater for cementless prosthesis (BFX cup/stem = 5, CFX cup/stem = 1, Hybrid = 1 (BFX cup/CFX stem), Kyon = 2) compared to cemented implants.

An overt limitation of this study is that surgeon experience is not analysed as a variable. As detailed previously, during the initial set-up of the BVOA-Canine Hip Registry, participating surgeons signed a confidentiality disclosure agreement (CDA) with Liverpool Veterinary School which is a legally binding agreement stating that the variables of “surgeon” or “clinic” will never be used in data analyses. In this way, we aimed to avoid any concerns caused by commercial pressures and encourage data submission. The ability to categorise surgeon experience is a difficult one; whether this is based on number of years as a registered specialist, years since completion of a certified hip replacement teaching course, number of cases submitted or number of cases carried out per surgeon/clinic per year. When using years of experience/cases carried out as a determination of skill, it would prove difficult when reviewing data over a period of time (collation of data), based on the need to alter this with each subsequent year.

A noteworthy limitation of this study is that potential change in prostheses design is not accounted for. Subtle variations with prosthetic design have not been recorded via the online registry. It clear that at this time point, that the number of cases of BFX, Helica and Kyon designs do not allow for further subcategorising and statistical analysis. With ongoing collection and subsequent collation of data the number of cases per prosthetic type should increase the strength of further analyses.

***Conclusion***

A significant decrease in the LOAD score and owner satisfaction after THR, even when reported up to 36 months following THR. Complication rates from the BVOA-CHR are similar to previous studies. These first comparator results suggest a significant difference in complication rate with prosthesis type, with Biomedtrix BFX having a high short-term complication rate. The results are not suggestive of an association between aseptic loosening and the use of a cemented prosthesis type, however the follow up time is relatively short.

***Footnotes***

I Microsoft Excel 2011, Microsoft

II SPSS Inc. SPSS Statistics for Mac, Version 20.0. Armonk, NY: IBM Corp

III BioMedtrix, LCC, Boonton, NJ

IV Helica Instruments Ltd., Riccarton, Edinburgh, UK

V Kyon Pharma, Inc., Zurich, Switzerland

***Disclosure***

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Table 1. Prosthetic type cross-tabulated with Complication Type. Data recorded by surgeon or owner, January 2010 – December 2012

| | Acetabular Fracture | Femoral Fracture | Luxation | Aseptic Loosening | Wound Complications | Other | Total Complications | Total Number of Cases |
|---|---|---|---|---|---|---|---|---|
| BFX | - | 5 | 2 | 2 | 3 | 1 | 13 | 39 |
| CFX | - | 1 | 5 | - | 2 | 3 | 11 | 140 |
| Hybrid | 2 | 1 | 1 | - | 3 | 1 | 8 | 74 |
| Helica | - | - | 2 | 4 | - | - | 6 | 34 |
| Kyon | - | 2 | 1 | - | 1 | - | 4 | 19 |
| | | | | | | | 42 | 306 |

*In some instances cases with complications had more than one type of complication i.e. Cases with complications = 38, Total Complications = 42

Table 2. Prosthetic type cross-tabulated with Complication Severity (25). Data recorded by surgeon or owner, January 2010 – December 2012

| | Catastrophic Complications | Major Complications | Minor Complications | Total Complications | Total Number of Cases |
|---|---|---|---|---|---|
| BFX | - | 13 | - | 13 | 39 |
| CFX | - | 8 | 3 | 11 | 140 |
| Hybrid | 1 | 7 | - | 8 | 74 |
| Helica | - | 6 | - | 6 | 34 |
| Kyon | 1 | 3 | - | 4 | 19 |
| | | | | 42 | 306 |

*In some instances cases with complications had more than one type of complication i.e. Cases with complications = 38, Total Complications = 42

Table 3. Prosthetic type cross-tabulated with Complication Occurrence. Data recorded by surgeon or owner, January 2010 – December 2012

| | Number of Cases without Complications | Number of Cases with Complications | Total Number of Cases | Complication Rate % |
|---|---|---|---|---|
| BFX | 29 | 10 | 39 | 25.6 |
| CFX | 130 | 10 | 140 | 7.1 |
| Hybrid | 66 | 8 | 74 | 10.8 |
| Helica | 28 | 6 | 34 | 17.6 |
| Kyon | 15 | 4 | 19 | 21.1 |
| | 268 | 38 | 306 | 12.4 |

* In some cases, more than one type of complication occurred. However, statistical analysis was completed on the basis of whether the case had a complication, be that one or several.